Original article

Relationship between oral health characteristics and lung disease among Korean adults

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Abstract

Background: Lung disease is known to be closely related to oral health. However, there is a lack of research on the relationship between lung disease and oral health in Korean adults. In this regard, lung disease is known to be closely related to oral health, but there is a lack of research on the relationship between lung disease and oral health in Korean adults.

Objective: The purpose of this study is to evaluate the status of lung disease in relation to the oral health status of Korean adults. In previous studies, the relationship between oral health and lung disease was not clearly established. There is a need, therefore, to identify the associations between oral health and lung disease

Methods: The subjects were recruited from community health centers and several hospitals and were analyzed and classified into three groups: normal, restrictive lung disease, and obstructive lung disease. The total number of cases was 2,643. Data used in this study were from the 6th National Health and Nutrition Examination Survey (2015), produced by Korea Centers for Disease Control and Prevention. Analysis of variance and Duncan post-hoc tests were performed to determine the oral health characteristics of subjects in all three groups.

Results: Based on a comparative analysis of the status of teeth, gingiva, prosthesis and oral care in patients with normal lungs, restrictive lung disease and obstructive lung disease, those with lung disease had a significantly higher incidence of periodontal tissue, prosthesis condition and periodontal disease compared to normal subjects. Through this study, patients with lung disease had significantly higher incidence of deteriorated periodontal tissue and periodontal disease compared to normal subjects.

Conclusion: From the study, we can say that the relationship between lung disease and oral health is significantly positive correlate. So, there is a need to consider periodontal tissue, prosthesis condition, temporomandibular joints, and the presence of the periodontal disease among lung disease patients This study also highlights the necessity of oral health education awareness-raising programs for patients with lung diseases. [*Ethiop. J. Health Dev.* 2018;32(4):257-264]

Keywords: Lung disease patients, oral health, education program, Korean adults

Introduction

There are many different lung diseases, but the most common are restrictive lung disease and chronic obstructive pulmonary disease (COPD). Restrictive lung disease is characterized by reduced lung capacity, including reduced total lung capacity, due to intrinsic parenchymal diseases, such as hypersensitivity pneumonia and pneumoconiosis; or extrinsic neuromuscular disorders that affect the function of respiratory muscles, such as scoliosis and diaphragmatic neuropathy (1). Patients with restrictive lung disease often suffer from myalgia, exercise tolerance, and dyspnea during daily activities. The quality of life associated with their health is decreased (2). In a review of the Korea National Health and Nutrition Examination Survey, 11.3% of 15,073 patients over 40 years of age were defined as having 'restricted ventilatory defects'. The prevalence rate increased to 12.3% when the lower limit of 'normal' was used (3).

COPD is a progressive disease characterized by chronic airway inflammation and airflow obstruction that cannot be completely restored. It often coexists with other complications, reducing the quality of life and physical function of patients. This disease is a major cause of global mortality and morbidity and carries a severe socio-economic burden. Korea spent $2.8 billion on COPD medical expenses in 2010. Its prevalence rate was 7.5% globally in 2010. In Korea, 13% of adults are over the age of 40 and 31.9% are over 65. The prevalence and mortality of this disease in Korea are expected to increase due to the rapid increase in life expectancy. Many studies have shown that the major cause of chronic obstructive lung disease is smoking (4-10). As described above, COPD is associated with periodontal disease (11) and periodontal damage (12,13), and markers of periodontal disease have been reported to reduce spirometry and airflow limitation (14,15). These considerations render a link between oral health and lung disease, especially COPD, plausible. Systemic inflammation and recurrent exacerbations of chronic inflammation, often due to bacterial infections, are of major importance for the progression of COPD. Conversely, the presence of COPD and its associated frequent infections could impair oral health (16), although such interactions could be substantially confounded by socioeconomic status, lifestyle, education, dental care, medication and smoking habits.

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The main treatment for chronic obstructive lung disease is smoking cessation through behavior changer (17). Smoking cessation prevents the progression of chronic obstructive lung disease, increases the survival rate, and reduces morbidity (18). Regarding drug treatment, bronchodilators, including beta-2 agonists and anticholinergics, are mainly used. However, the long-term use of inhalants has been reported to adversely affect oral health, leading to tooth decay, candidiasis, ulcers and gingivitis (19). It is hard to control the dose of the inhaled drug, and most of the inhaled drug remains in the mouth and pharynx, which can interfere with the normal physiological function of oral tissues. Therefore, oral hygiene management is emphasized, including regular dental examinations at least every six months, brushing, flossing, and mouthwash after every meal. A balanced diet is also recommended (20).

Based on the fact that lung disease among others plays vital role in the respiratory pathway (21), understanding the oral status of patients with lung disease is important. It is well known that systemic diseases have a close correlation with oral health (22), including lung disease. There are many studies on other diseases such as diabetes in Korea (23). However, the correlation between lung disease and the oral status of patients has not yet been established. However, we can conjecture that there is an association between two.

The purpose of this study was to investigate the effects of lung disease on the oral cavity through comparative analyses of the status of teeth, gingiva, prosthesis and oral care, in patients with normal lungs, restrictive lung disease and obstructive lung disease.

Methods

Measurement procedure: All the subjects who participated in the study were evaluated for oral health characteristics (decayed treatment (DT), decayed, missing, filled treatment(DMFT), oral health status), prosthesis characteristics (maxillary prosthesis status, mandibular prosthesis status), periodontal characteristics (maxillary right posterior, maxillary left posterior, mandibular right posterior, anterior, mandibular left posterior, periodontal disease status) and oral health care characteristics (the use of auxiliary oral health products, temporomandibular joint, treatment).

Data collection and analysis: Data used in this study were from the 6th National Health and Nutrition Examination Survey (2015) produced by Korea Centers for Disease Control and Prevention (KCDC). To analyze characteristics of patients with lung disease, we classified them after excluding cases for which pulmonary function tests were impossible. The total number of cases was 2,643.

Analysis of variance (ANOVA) test was performed to determine the oral health characteristics of patients with lung disease according to the type of lung disease (normal, restrictive lung disease, obstructive lung disease). Duncan post-hoc testing was performed to determine the statistical significance at the level of 0.05.

Ethical considerations: This survey was conducted with the approval of the Research Ethics Review Committee of Korea Centers for Disease Control and Prevention (KCDC). All subjects were volunteers, and after as the first step for the research, they were accepted and participated in the study.

Results

The results were classified into four categories of characteristics –oral health, prosthesis, periodontal and oral health care.

Oral health characteristics of the study participants: As a result of this study, the DMFT index of patients with obstructive lung disease was 8.53 ± 6.76, which was significantly ($p< 0.05$) higher than that among patients with normal lungs (7.42 ± 5.49) or restrictive lung disease (7.13 ± 5.83). However, there was no significant difference in the DT index or oral health status among groups (Table 1).

Prosthesis characteristics of the study participants: *The prevalence of* maxillary prosthesis was highest in patients with obstructive lung disease (1.44 ± 1.65), followed by restrictive lung disease patients (0.94 ± 1.38) and normal patients (0.68 ± 1.16). Equally, prevalence of mandibular prosthesis status was highest in patients with obstructive lung disease (1.24 ± 1.52), which was significantly ($p < 0.05$) higher than in patients with restrictive lung disease (0.84 ± 1.52) and normal patients (0.72 ± 1.12) (Table 2).

Table 1**: Classification of oral health status according to lung disease**

Classification	Number	Mean	Standard deviation	Expected Mean Square	F-ratio	p value	Post hoc (Duncan)
#DT index							
Normal[a]	2,031	.50	1.328	1.860†			
Restrictive lung disease[b]	239	.58	1.727	1.968‡	.945	.389	-
Obstructive lung disease[c]	373	.59	1.559				
Overall	2,643	.52	1.403				
##DMFT index							
Normal[a]	2,031	7.42	5.487	218.315†			
Restrictive lung disease[b]	239	7.13	5.828	32.650‡	6.687	.001***	a, b<c
Obstructive lung disease[c]	373	8.53	6.757				
Overall	2,643	7.55	5.726				
Subjective oral health status							
Normal[a]	2,031	3.40	.909	1.389†			
Restrictive lung disease[b]	239	3.36	.892	.836‡	1.662	.190	-
Obstructive lung disease[c]	373	3.48	.955				
Overall	2,643	3.41	.914				

*DT: decayed treatment, **DMFT: decayed, missing, filled treatment
†within group, between group

Table 2: **Classification of prosthesis lung disease**

Classification	Number	Mean	Standard deviation	Expected Mean Square	F-ratio	P value	Post hoc (Duncan)
Maxillary prosthesis status							
Normal[a]	2,031	.68	1.157	92.532†			
Restrictive lung disease[b]	239	.94	1.375	1.584‡	58.435	0.000***	a<b<c
Obstructive lung disease[c]	373	1.44	1.649				
Overall	2,643	.81	1.285				
Mandibular prosthesis status							
Normal[a]	2,031	.72	1.124	43.018†			
Restrictive lung disease[b]	239	.84	1.243	1.436‡	29.951	.000** *	a, b<c
Obstructive lung disease[c]	373	1.24	1.521				
Overall	2,643	.80	1.212				

***p<.001, †within-group, ‡between-group

Periodontal characteristics of the study participants: Periodontal status was divided into six parts: maxillary right posterior, maxillary anterior, maxillary left posterior, mandibular right posterior, mandibular anterior and mandibular left posterior (Table 3). There were statistically significant ($p< 0.05$) differences in status among parts. For maxillary right posterior periodontal status, patients with restrictive lung disease (1.48 ± 1.53) and obstructive lung disease (1.32 ± 1.54) were higher than normal patients (1.01 ± 1.42). For maxillary anterior periodontal status, patients with restrictive lung disease (0.63 ± 1.20) and obstructive lung disease (0.63 ± 1.19) were higher than normal patients (0.45 ± 1.02).

Table 3: **Classification of periodontal lung disease**

Classification	Number	Mean	Standard deviation	Expected Mean Square	F-ratio	P value	Post hoc (Duncan)
Maxillary right posterior periodontal status							
Normal[a]	1,810	1.01	1.418	27.442†			
Restrictive lung disease[b]	200	1.48	1.527	2.081‡	13.187	0.000**	a<b, c
Obstructive lung disease[c]	265	1.32	1.539			*	
Overall	2,275	1.09	1.450				
Maxillary anterior periodontal status							
Normal[a]	1,942	.45	1.015	6.554†			
Restrictive lung disease[b]	220	.63	1.196	1.116‡	5.870	0.003**	a<b, c
Obstructive lung disease[c]	315	.63	1.194				
Overall	2,477	.49	1.059				
Maxillary left posterior periodontal status							
Normal[a]	1,823	.93	1.384	11.573†			
Restrictive lung disease[b]	201	1.25	1.497	1.962‡	5.897	0.003**	a, c<b, c
Obstructive lung disease[c]	261	1.09	1.442				
Overall	2,285	.97	1.404				
Mandibular right posterior periodontal status							
Normal[a]	1,850	.85	1.279	28.610†			
Restrictive lung disease[b]	207	1.35	1.444	1.718‡	16.651	0.000**	a<c<b
Obstructive lung disease[c]	290	1.10	1.407			*	
Overall	2,347	.93	1.320				
Mandibular anterior periodontal status							
Normal[a]	1,967	1.18	1.077	4.206†			
Restrictive lung disease[b]	226	1.36	1.079	1.178‡	3.572	.028*	a, c<b, c
Obstructive lung disease[c]	338	1.28	1.134				
Overall	2,531	1.21	1.086				
Mandibular left posterior periodontal status							
Normal[a]	1,841	.75	1.234	19.394†			
Restrictive lung disease[b]	207	1.13	1.403	1.593‡	12.177	.000***	a<b, c
Obstructive lung disease[c]	287	1.01	1.333				
Overall	2,335	.82	1.268				
Presence of periodontal disease or not							
Normal[a]	1,998	.39	.489	2.422†			
Restrictive lung disease[b]	233	.52	.501	.241‡	10.034	.000***	a<b, c
Obstructive lung disease[c]	349	.48	.500				
Overall	2,580	.42	.493				

*p<.05, **p<.01, ***p<.001, †within group, ‡between group

Maxillary left posterior periodontal status was higher in patients with restrictive lung disease (1.25 ± 1.48) than in normal patients (0.93 ± 1.38). For mandibular right posterior periodontal status, the highest was in patients with restrictive lung disease (1.35 ± 1.44), followed by patients with obstructive lung disease (1.10 ± 1.41) and normal patients (0.85 ± 1.28).

For patients with restrictive lung disease, mandibular anterior periodontal status was higher (1.36 ± 1.08) than in normal patients (1.18 ± 1.08). For patients with restrictive lung disease and obstructive lung disease, mandibular left posterior periodontal status was higher (1.13 ± 1.40; 1.01 ± 1.33, respectively) than in normal patients (1.28 ± 1.13). Regarding the presence of periodontal disease, patients with restrictive lung disease (0.52 ± 0.50) and obstructive lung disease (0.48 ± 0.50) were significantly (p< 0.05) higher than normal patients (0.39 ± 0.49).

Oral health care characteristics of the study participants: In response to the question whether respondents had brushed their teeth yesterday, the number of 'yes' responses was highest in normal patients (99%), followed by patients with restrictive lung disease (97.6%) and patients with obstructive lung disease (96.2%). The differences among the groups were statistically significant (p<0.001) (Table 4).

Regarding the distribution of auxiliary oral hygiene products used, mouth rinse was the highest (26.0%), followed by dental floss (19.8%), inter dental toothbrushes (15.9%), and electric toothbrushes (4.7%). However, the use of auxiliary oral hygiene products was relatively low overall. The number of subjects using dental floss, mouth rinse, and inter dental brushes

was highest in the normal patient group (21.6%, 27.6%, 16.8%, respectively), followed patients with restrictive lung disease (17.8%, 23.9%, 15.0%, respectively) and patients with obstructive lung disease (11.2%, 18.5%, 11.4%, respectively). Differences among the groups were statistically significant.

Table 4: **Classification of oral health care according to lung disease**

	Normal (n=1,228)	Restrictive lung disease (n=133)	Obstructive lung disease (n=229)	Total (n=1,590)	x^2
Used supplies					
Dental floss					
No	78.4	82.2	88.8	80.2	23.692***
Yes	21.6	17.8	11.2	19.8	
Interdental brush					
No	83.2	85.0	88.6	84.1	7.530*
Yes	16.8	15.0	11.4	15.9	
Mouthrinse					
No	72.4	76.1	81.5	74.0	15.059***
Yes	27.6	23.9	18.5	26.0	
Temporomandibular joint					
Chewing problem					
Very uncomfortable	5.5	7.3	9.4	6.2	
Uncomfortable	19.7	20.2	26.6	20.7	
Normal	18.3	22.3	18.0	18.6	28.604***
Comfortable	23.0	18.6	21.3	22.4	
Very comfortable	33.5	31.6	24.6	32.1	
Expressing chewing discomfort or not					
No	74.8	72.5	64.0	73.1	19.849***
Yes	25.2	27.5	36.0	26.9	
Speaking problem					
Very uncomfortable	1.7	3.6	3.6	2.1	
Uncomfortable	7.6	7.7	16.0	8.7	
Normal	12.4	17.0	19.0	13.8	65.158***
Comfortable	20.2	19.4	19.5	20.0	
Very comfortable	58.1	52.2	41.9	55.4	
Treatment items					
Preventive treatment					
No	46.8	56.4	56.8	49.1	10.762**
Yes	53.2	43.6	43.2	50.9	
Tooth extraction or Intraoral surgery					
No	85.6	87.2	78.6	84.7	7.972*
Yes	14.4	12.8	21.4	15.3	

*p<.05, **p<.01, ***p<.001

The number of users of electric toothbrushes was highest in patients with restrictive lung disease. However, differences among groups were not statistically significant.

In relation to temporomandibular joint problems, the severity of chewing and speaking problems were scored 1 to 5. A total of 73.1% and 89.2% of subjects answered ‘above 3’ in relation to whether they had a chewing or speaking problem, which shows that both

were severe overall. A total of 32.1% and 55.4% of subjects answered '5', which was the highest score. There were statistically significant differences for both problems. Overall, 26.9% of subjects expressed chewing discomfort. Patients with obstructive lung disease (36.0%) had the highest percentage, followed by patients with restrictive lung disease (27.5%) and normal patients (25.2%). There were statistically significant differences in these percentages. Among the subjects overall, 34.6% visited dental clinic for the past year while 56.1% of them visited dental clinic in the past year. However, there was no significant difference among the groups.

After examining and categorizing dental treatment procedures, 'oral examination' (82.3%) was most common, followed by 'preventive treatment' (50.9%), 'periodontal treatment' (30.1%), 'manufacturing and repairing of prosthetics' (29.2%), 'simple cavity treatment' (29.0%), 'endodontic treatment' (23.7%), 'tooth extraction or intraoral surgery' (15.3%) and 'odontoclasis treatment' (2.0%). For patients who received 'preventive therapies', the proportion of normal patients (53.2%) was significantly higher than that of patients with restrictive lung disease (43.6%) and those with obstructive lung disease (43.2%). For 'tooth extraction or intraoral surgery' and 'manufacturing and repairing of prosthetics', patients with obstructive lung disease (21.4% and 36.7%, respectively) had significantly higher proportions than normal patients (14.4% and 28.1%, respectively) and patients with restrictive lung disease (12.8% and 27.1%, respectively).

Discussion

In this study, the DMFT index was 8.53 ± 6.76 in patients with obstructive lung disease, which was significantly higher than that of normal subjects (7.42 ± 5.49) and patients with restrictive lung disease (7.13 ± 5.82). Periodontal status in patients with lung disease was also significantly higher than normal subjects, for all six parts. However, there was no significant difference in the DT index among groups.

In a study of the oral health status of patients with diabetes, the DMFT index was found to be significantly higher in the diabetic group than in the normal group. However, there was no significant difference in the DT index between the two groups. Periodontal disease index was also significantly higher in the diabetic group than in the normal group (24). Our findings are consistent with these results. Therefore, the relationship between lung disease and oral health status is significant and is also shown in diabetes study (25).

In this study, patients with lung disease had a significantly higher status of periodontal tissue, prosthesis condition, and presence of periodontal disease than normal subjects. Conversely, Bergström *et al.* report that periodontitis and obstructive pulmonary disease are not associated with each other, except for low diffusion rates. However, their study had a limitation in that the population sample was low (26).

In other studies, there was a significant correlation between probing depth (PD), attachment loss (AL), plaque index (PI), and alveolar bone loss; and the number of teeth is significantly correlated with all stages of obstructive lung disease (27).
Furthermore, more severe obstructive lung disease patients are more likely to have severe periodontal disease. This is supported by the results of the present study.

In terms of oral hygiene behavior, the use of toothbrushes and auxiliary oral hygiene products were lower in patients with lung disease than in normal subjects. The percentage of subjects who received preventive treatment was 10% lower among patients in the lung disease than those in the normal group. Accordingly, oral care was not properly performed by patients with lung disease, although they had poor oral status. In the oral hygiene behavioral test of this study, periodontal health and oral hygiene improvement have a potentially preventive effect because the low number of residual teeth, high PI index, and short brushing time are significantly related to the deterioration associated with obstructive lung disease'. It has also been reported that experience with inadequate toothbrush time and methods, low experience using dental floss, low dental visits and periodic supragingival calculus scaling, as well as low oral health knowledge, are significantly associated with the risk of obstructive lung disease (28,29). These results suggested that periodontal health, dental management, and low knowledge about oral health were significantly related to increasing risk of obstructive lung disease. In another study, poor teeth status, including deficit and PI, was reported to reduce the quality of life of patients with COPD (30). They concluded that it was important to promote dental management in public health strategies to improve the quality of life of patients. Therefore, it is important to emphasize the necessity of oral hygiene management for patients with lung diseases and to improve oral health care.

As described above, lung disease is closely related to oral health status. In particular, a number of studies on oral health status and COPD have made a link between the two. Relevant previous research documented the association between oral health-related quality of life (OHRQoL) and mental health-related quality of life (QoL) in patients with COPD, health survey mental component (MCS). It has been shown that QoL and OHRQoL are related to the oral health and mental health of COPD patients, so it is necessary to clean the oral cavity in order to lower the risk of lung disease (31). With the correlation between oral health and lung disease (COPD), the subjects were classified as non-smokers (n = 23), smokers without COPD (n = 29) and smokers with COPD (n = 28). The results of radiographs, dental laboratory tests, pulmonary function tests and quality of life (SF-36) tests indicate that periodontitis is closely related to smoking, pulmonary function is also somewhat weakened (32). As age increases, patients with COPD become more prone to plaque, and teeth, dentures and periodontal disease increase, leading to chronic oral disease.

Therefore, long-term oral treatment is essential (33).

The present study also examined problems related to the temporomandibular joints, in addition to general teeth, periodontal status and oral behavior. The percentage of patients who experienced chewing discomfort was significantly higher in the group with obstructive lung disease than in the other two groups. Therefore, future studies are needed to determine the correlation of lung disease with the oral health conditions and temporomandibular joints, and to design health programs for patients with lung disease.

Conclusion:
Patients with obstructive lung disease had more permanent teeth than those with normal lungs and those with restrictive lung disease, and the periodontal status index was significantly higher in patients with lung disease than in normal subjects. In addition, in the oral behavior questionnaire, the use of brushing and auxiliary items was lower in patients with lung disease than in normal patients; and those who received preventive treatment were 10% lower in patients with lung disease than those of normal subjects. Note that this oral care was also related to the temporomandibular joints.

In general, education about oral health status in Korea is insufficient. It is thought that this will contribute to increasing cost of medical insurance in the future, so early education is needed from school age, as well as for adults. In particular, it is imperative to provide children with various programs for oral health, and adults should be aware of the importance of oral health care in relation to the dangers of smoking and lung disease.

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Conflict of interest
The authors declare that they have no conflicts of interest related to this study

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